

## Empirical return and risk properties of hedge funds

There is now a solid body of empirical research on the historical performance of hedge funds, as well as the benefits investors receive by including them in their overall portfolios.<sup>1</sup> This chapter restates, summarizes and extends the results of existing studies on empirical risk and return properties on the basis of different hedge fund performance indices.<sup>2</sup> The various studies have applied a broad range of statistical measures, including expected return, volatility, higher moments (skew and kurtosis), maximal drawdowns and various correlation attributes. However, the financial industry has not yet arrived at a consensus on what performance and risk measures are best to characterize the complexity of hedge fund returns.<sup>3</sup> Therefore, the issues involved in measuring that complexity will also be discussed, together with the conditional performance and correlation properties of the various hedge fund strategies, which show how hedge funds behave in different market environments, plus how hedge funds fared in the extreme market circumstances of recent years. Finally, the last part of the chapter discusses how hedge funds act in the context of the global investor's portfolios, where I will introduce some new techniques of considering the non-normal properties of hedge funds in the quantitative process portfolio optimization.

### When the Sharpe ratio is not sharp enough

Hedge fund proponents often make their case by pointing out hedge funds' attractive reward to risk characteristics, as well as their low correlations to traditional assets. The most often-cited measure of risk-adjusted performance is the Sharpe ratio. The Sharpe is the ratio of annualized monthly returns (minus the benchmark risk-free return) and the annualized monthly volatility. A higher Sharpe ratio is said to represent a more desirable risk/return profile.

Hedge funds' high Sharpe ratios support the claim that hedge funds have much lower risk than equity investments, while yielding similar levels of returns. However, unlike equities, some hedge fund strategies show negative outbreaks exceeding the range of three or more standard deviations, much more frequent than expected by a normal distribution (as do stocks, but to a smaller degree). That is, these strategies show kurtosis (a fatness of the tails of the distribution)<sup>4</sup> and negative skew (an asymmetry in the size of negative returns versus the size of positive returns). This tail risk is of major concern to investors and remains unrecorded if only standard deviations are used for hedge fund risk quantification. Numerous studies (see endnote 1 in this chapter) have highlighted the importance of the higher order moments of the return distributions when describing the performance and risk characteristics of hedge funds.

## Challenges of hedge fund performance measurement

The performance characteristics of hedge funds presented in this chapter rely on a set of hedge fund return indices developed by commercial data providers. Although these may be the best measurements of the industry's average performance currently available, they should still be viewed with caution due to several significant problems. First, unlike traditional asset classes, where performance data is readily available and fairly reliable, the reporting infrastructure for hedge funds is insufficiently developed. While several data providers have emerged, data availability and quality does not yet compare to traditional asset classes. Secondly, the variability of manager performance within strategy sectors is significantly larger for the hedge fund universe than for traditional equity and fixed income investments. This makes performance analysis based on indices and averages of manager sets less representative. Thirdly, hedge fund data and indices come with a set of nasty biases. Some of these are well-known in the world of traditional investments, but they are magnified by the still rather non-transparent nature of the hedge fund industry. The three most important of these biases – survivorship, asset weighting and selection bias – are discussed in detail in Chapter 9.

### Sources of empirical data

For all their flaws, the current hedge fund indices provide the best empirical basis for the analysis of performance of the various hedge fund strategy sectors. In this survey, an attempt is made to offset some of the shortcomings of each individual index by using three different indices.

1. The Credit Suisse First Boston (CSFB) Tremont indices. This series of asset-weighted indices and has been adjusted for survivorship bias since its inception in January 1994.
2. The Hedge Fund Research (HFR) indices. This series of indices is equally weighted among managers and has been adjusted for survivorship bias since 1995. Some indices began in 1987, but this chapter concentrates mainly on the set beginning in January 1994. The HFR Index does not include managed futures strategies.
3. The CISDM (formerly Zurich and MAR) indices for managed futures strategies. These indices date back to the early 1980s, but again the emphasis here will be mostly on data beginning from January 1994.

### Risk and return

Exhibit 4.1 presents the results of a risk/return analysis for the different hedge fund strategy sectors from January 1994 to September 2004. The table compares performance of the HFR, CSFB Tremont, and CISDM indices with that of representative traditional indices. Returns are calculated on monthly data as geometric averages (cumulative returns) of the log-differences of consecutive (monthly) prices. The volatility calculation is based on the standard deviation of log-returns.

As can be seen, the average annual returns for the aggregate of all hedge funds stands at 11.5% and 10.7% according to the HFR and Tremont indices. These returns come with a volatility of 7.3% and 8.2%, respectively. The average investor in a fund of hedge funds saw his investment rise 7.2% per year with a volatility of 6.0% according to the HFR fund of funds index.

The risk/return properties of the different hedge fund strategy sectors are very hetero-

## Exhibit 4.1

**Risk and return of hedge fund strategies as measured by different index families, January 1994–September 2004**

	<i>Return (%)</i>	<i>Volatility (%)</i>	<i>Skewness</i>	<i>Excess kurtosis</i>	<i>Maximum drawdown (%)</i>	<i>Sharpe ratio</i>
<b>Distressed securities</b>						
HFRI	12.09	5.59	-1.82	10.12	-12.78	1.29
<b>Long/short equity</b>						
HFRI	14.62	9.14	0.17	1.67	-10.30	1.06
Tremont	11.65	10.57	-0.00	3.78	-15.04	0.64
<b>Equity market neutral</b>						
HFRI	8.14	3.21	0.24	0.48	-2.72	1.01
Tremont	10.40	3.01	0.23	0.22	-3.54	1.83
<b>Event-driven</b>						
HFRI	13.40	6.58	-1.47	6.47	-10.78	1.29
Tremont	11.26	5.98	-3.87	27.85	-16.05	1.07
<b>Macro</b>						
HFRI	10.26	7.48	-0.03	0.87	-10.70	0.72
Tremont	13.82	11.62	-0.21	2.50	-26.79	0.77
<b>Market timing</b>						
HFRI	10.95	6.87	0.19	-0.47	-5.50	0.88
<b>Regulation D</b>						
HFRI*	17.85	7.24	0.56	1.63	-12.42	1.79
<b>Relative value</b>						
HFRI	9.95	3.24	-2.87	20.42	-6.55	1.57
Convertible arbitrage (HFRI)	10.27	3.55	-1.10	2.50	-4.84	1.51
Convertible arbitrage (Tremont)	9.78	4.72	-1.53	4.03	-12.03	1.04
Fixed income arbitrage (HFRI)	5.98	4.12	-3.19	17.06	-14.42	0.27
Fixed income arbitrage (Tremont)	6.69	3.92	-3.35	17.96	-12.48	0.46
<b>Short selling</b>						
HFRI	1.07	22.41	-0.08	1.64	-53.36	-0.17
Tremont	-2.34	17.35	0.68	1.32	-44.37	-0.42
<b>Fund of funds</b>						
HFRI	7.16	5.97	-0.35	4.70	-13.08	0.38
<b>Composite</b>						
HFRI	11.51	7.27	-0.63	3.52	-11.42	0.91
Tremont	10.68	8.15	-0.02	2.06	-13.81	0.71
<b>Managed futures</b>						
Tremont	6.04	8.65	-0.10	0.56	-17.74	0.12
CISDM qualified universe	7.71	8.65	0.20	-0.09	-8.25	0.33
CISDM systematic active	6.39	9.35	0.25	0.36	-8.32	0.16
CISDM discretionary active	8.29	4.97	0.33	0.25	-5.60	0.69
CISDM trend-following	8.52	14.22	0.21	-0.10	-14.93	0.26
Passive (sGFI)	12.11	12.09	-0.71	1.64	-22.57	0.60
<b>Currency trading</b>						
Barclay Currency Index	4.66	6.90	1.00	1.05	-14.83	-0.03

Exhibit 4.1 *continued***Risk and return of hedge fund strategies as measured by different index families, January 1994–September 2004**

	<i>Return (%)</i>	<i>Volatility (%)</i>	<i>Skewness</i>	<i>Excess kurtosis</i>	<i>Maximum drawdown (%)</i>	<i>Sharpe ratio</i>
<b>Equity)</b>						
S&P 500 TR	10.41	15.47	−0.73	0.78	−44.73	0.36
MSCI World TR USD	6.93	14.61	−0.76	1.05	−46.26	0.14
MSCI EU TR USD	8.89	15.68	−0.61	1.20	−45.50	0.26
<b>Bonds</b>						
SSB World Gov Bond USD	6.47	6.53	0.29	0.49	−7.94	0.24
Lehman U.S. Bond Index	7.59	7.99	−0.24	0.38	−11.72	0.34
CSFB High Yield Index	6.55	4.78	−0.58	1.11	−5.34	0.35
<b>Commodities</b>						
Goldman Sachs Commodity Index	10.13	19.29	−0.03	0.24	−48.25	0.27

\* January 1996 to September 2004.

*Source:* Calculations by the author based on HFR Tremont and MAR data from January 1994 to September 2004.

geneous. For example, in global macro and long/short equity strategies, high returns come with high risk. Just how high the risks and returns appear, however, varies between indices. CSFB Tremont shows an average annual return for global macro funds of 13.8% per annum over the period. But with 11.6% standard deviation, global macro ranks among the most volatile strategies. CSFB Tremont assigns the strategy a Sharpe ratio of 0.77. In contrast, HFR gives global macro an average annual return of 10.3%, a volatility of 7.5% and a Sharpe ratio of 0.72. Long/short equity also displays high returns and high risk. HFR reports a 14.6% annualized return, 9.1% volatility and a Sharpe ratio of 1.06, while Tremont reports an 11.7% return, 10.6% volatility and a 0.64 Sharpe ratio. The kurtosis numbers for long/short equity strategies are slightly higher than those for global macro. Neither long/short equity nor global macro display significant skew in their historical return distribution.

Providing slightly lower average returns, but better stability on the risk side, are event-driven, equity market neutral, convertible arbitrage and distressed securities strategies. Equity market neutral strategies demonstrated particularly impressive risk-adjusted performance in both the HFR and Tremont databases. With returns of 8%–10% and a low volatility of 3.2%, the strategies show an impressive Sharpe ratio. Event-driven displays attractive double-digit returns with volatilities of around 6%, but has a significant skew (negative) and kurtosis.

Drawdown statistics help the investor to further differentiate between the strategies in terms of risk beyond volatility. Note, however, the large deviation in the drawdown figures between the HFR and Tremont databases for global macro, long/short equity, convertible arbitrage and event-driven strategies. While the equal weighted HFR Global Macro Index shows the most severe drawdown of −10.7%, the asset-weighted Tremont index shows a substantially worse −26.8% in an overall shorter time period. The deviations for long/short equity and event-driven strategies are less remarkable, but still significant, at −10.3% HFR

versus  $-15.0\%$  Tremont for long/short equity and  $-10.8\%$  HFR versus  $-16.1\%$  Tremont for event-driven. For convertible arbitrage, HFR displays a quite low drawdown of  $-4.8\%$ , compared with  $-12.0\%$  for the CSFB Tremont index. The wide differences between the two databases underline the value of understanding both the way data is collected, and what that data truly represents.

The equity market neutral strategy shows the lowest drawdown in the hedge fund strategy universe. According to HFR data, convertible arbitrage strategies experienced their single worst drawdowns in the single digits, significantly lower than fixed income arbitrage. In contrast, event-driven, Regulation D, and distressed securities strategies exhibited drawdowns of about double these amounts.

Looking further at kurtosis provides an even more complete picture.

- *Fixed income arbitrage*: 17.1 (HFR) and 18.0 (Tremont).
- *Convertible arbitrage*: 2.5 (HFR) and 4.0 (Tremont).
- *Distressed securities (HFR)*: 10.1.
- *Event-driven*: 6.5 (HFR) and 27.9 (Tremont).
- *Equity market neutral*: 0.5 (HFR) and 0.2 (CSFB/Tremont). These are statistically not different from zero.

The high kurtosis for fixed income arbitrage was largely caused by the events of fall 1998. Exhibit 4.1 shows that most hedge fund strategies come with a significant amount of negative skew in their return distribution, especially the event-driven (merger arbitrage, distressed securities) and the relative value strategies (convertible arbitrage, fixed income arbitrage). The negative skew and the excess kurtosis put the low volatility characteristics of these strategies into a new light. In exchange for lower risk in the second moment (the middle – normal – part of the return distribution) investors incur higher tail risks on the negative side of the distribution.<sup>5</sup> This is an important caution for when evaluating mean-variance optimized portfolios, which do not take the higher moments into account. Equity market neutral strategies in contrast display in the study neither a significant skew nor any kurtosis in their historical return distribution.

Short selling is clearly the worst performing strategy during the studied period. Suffering through a decade of bullish equity markets, short sellers returned an average of  $1.1\%$  with a volatility of  $22.4\%$  according to HFR, while CSFB Tremont reports negative return averages. The rather frightening maximum drawdown figure of  $-53.4\%$  sheds further light on the difficulties faced by these managers during the bull market of the 1990s. However, short selling strategies were not surprisingly among the best performers during the two years from 2001 to 2002 (although the exact results differed between the two indices).

Regulation D strategies showed average annual returns of  $17.9\%$  and volatility of  $7.2\%$ , yielding a Sharpe ratio of 1.79. The maximum drawdown was  $-12.4\%$ . However true volatility in this strategy, as well as the one for distressed securities strategies, are less accurately reported due to the lack of liquidity. In the absence of mark-to-market pricing, value appears to change infrequently. In fact, the true market value of such an investment may well change every day as the company's fortunes shift. However, these frequent changes are not marked by public market transactions. Absent frequent and recorded changes in pricing, volatility appears artificially low. The returns of this strategy partly represent a liquidity premium the investor receives for accepting a relatively long lock-up period, and arguably an additional

premium for the lack of mark-to-market valuations – that is, for holding an investment whose volatility cannot be easily calculated.

The stand-alone return-to-risk ratios of managed futures strategies are not quite as impressive as those of other hedge fund strategies. Their main value lies in their correlation attributes, which provide useful diversification within an overall portfolio. The average managed futures strategies yielded 7%–9% with volatilities even higher. The resulting Sharpe ratios are well below 0.5 on average. The performance of the sGFI, a systematic, passive, trend-following approach, stands out quite impressively.<sup>6</sup>

### Comparison with equities and bonds

The returns of hedge funds vary by strategy, but compare favorably both individually and collectively to the returns of traditional investments. In the equity markets – represented here by the S&P 500, the MSCI Europe and the MSCI World – return-to-risk ratios are generally lower than their hedge fund counterparts. The 1990s saw unprecedented growth in equity markets. Nonetheless, the 10.4% return (including dividends) and 15.5% volatility of the S&P 500 does not meet the standard of high return paired with low volatility set by a diversified hedge fund portfolio. From 2000–03 the S&P 500 experienced a 44.7% drawdown. The MSCI Europe Index's (including dividends) average annual return of 8.9% and volatility of 15.7% is even less inspiring, and the MSCI World (including dividends), with 6.9% returns (again including dividends) and 14.6% volatility is below the range of reasonable performance for an investment with this level of risk. The maximum drawdowns for the MSCI World Index stand at the very intimidating figure of –46.3%.

On the bond side of the equation, the news is hardly better. The Salomon Smith Barney World Government Bond Index (in U.S. dollar terms) and the Lehman U.S. Bond Index represent fixed income as the traditional complement to stocks. Although these indices' volatilities (6.5% and 8.0%) are comparable to hedge funds, their returns of 6.5% and 7.6% are significantly lower than those of the average hedge fund.

### Deviation from normal distribution

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